Image AF 8-5-6 18

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Alan Argento et al.

Group Art Unit: 2856

Examiner: J. Saint Surin

Serial No.: 10/091,188

Filed: March 4, 2002

For: METHOD AND SYSTEM FOR MEASURING VIBRATION OF AN OBJECT

Attorney Docket No.: UOM 0202 PUS

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an appeal brief from the final rejection of claims 1-19 of the Office Action mailed December 4, 2003. This application was filed on March 4, 2002.

I. REAL PARTY IN INTEREST

The real party in interest is The Regents of the University of Michigan, a non-profit corporation organized and existing under the laws of the state of Michigan, and having a place of business at 3003 S. State Street, Ann Arbor, Michigan 48109, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on March 4, 2002 at Reel 012678, Frame 0405.

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II. RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences known to appellants, the appellants' legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-19 are pending in this application. Claims 1-19 have been rejected and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

No amendment after the final rejection has been filed.

V. SUMMARY OF THE INVENTION

In one embodiment, the invention provides a system for measuring vibration of an object including an imaging sensor such as a video camera (10) as a vibration sensor, which demonstrates the measurement method. The camera (10) receives signals representative of the image of an object such as vibrating stage (14) of a mechanical shaker (11), whose vibration is to be measured, coupled to a computer system or other signal processing device or processor (20) to interpret the signals received for image content. The processor (20) is coupled to a display (22).

If not naturally so marked, the object or target (12) (target denotes the vibrating component) is marked with spaced-apart marks such as two lines that are parallel to each other and perpendicular to the image axis. However, it is to be understood that the spaced-apart

marks may be parts of a single line. Also, the spaced-apart marks may be replaced by a sine or cosine curve.

Standardized adhesive markers (14) containing parallel lines separated by a nominal distance may be used. A user only needs to attach the marker (14) to the target (12). When this target (12) is imaged using the video camera (10), the lines on the target (12) appear as two parallel lines in the image plane set apart by a nominal distance. As the target (12) moves (*i.e.*, vibrates) along the image axis, the nominal image plane distance between the two lines changes. As the target (12) moves away from the video camera (10) along the image axis, the distance between lines becomes smaller and vice-versa if the target (12) moves closer to the video camera (10). This apparent change in the distance between the parallel lines in the image plane is calibrated to the physical movement of the target (12) in space due to deformation or rigid body motions to obtain calibration data which is processed together with the signals generated by the video camera (10) to obtain a vibration measurement. Such calibration typically includes using the same video camera (10). (See, for example, Figure 1 and the specification on page 6, line 13 through page 7, line 10.)

VI. ISSUES

Whether the Examiner has made a *prima facie* case that the pending claims are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,134,006 to Telschow et al. (hereinafter "*Telschow*") in view of U.S. Patent No. 5,521,843 to Hashima et al. (hereinafter "*Hashima*").

VII. GROUPING OF CLAIMS

Applicants contend that the claims do not stand or fall together. In particular, Applicants contend the claims should be grouped as follows:

1. Claims 1-9 (Group I) stand or fall together.
2. Claims 10-19 (Group II) stand or fall together.

The claims in each of Groups I and II are believed to be separately patentable over the cited art. Group I provides a method of measuring vibration of an object having a pair of substantially coplanar, spaced-apart marks. Unlike Group II, which is directed to a system, Group I concerns a method, and is therefore believed to be separately patentable.

Group II provides a system for measuring vibration of an object having a pair of substantially coplanar, spaced-apart marks. The system of Group II includes specific types of apparatus or structures including a mechanism for generating and storing calibration data.

VIII. ARGUMENT

The Examiner has Failed to Make a Prima Facie Case that Claims 1-19 are Unpatentable Under 35 U.S.C. § 103(a) Over Telschow in View of Hashima

A *prima facie* case of obviousness requires three basic criteria:

> First, there must be some suggestion of motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.
>
> The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.
>
> MANUAL OF PATENT EXAMINING PROCEDURE (MPEP), 8th Edition, August 2001, revised February 2003, §2143 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)).

Furthermore, "[a] prior art reference must be considered in its entirety, *i.e.*, as a whole, including portions that would lead away from the claimed invention." MPEP §2141.02 (citing *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)).

Here, the Examiner has rejected claims 1-19 as being unpatentable under 35 U.S.C. § 103(a) over *Telschow* in view of *Hashima*. The Examiner has failed to establish, however, that the combination of *Telschow* and *Hashima* teach or suggest all the limitations of the Applicants' claimed invention. In particular, independent claim 1 provides a method for measuring vibration of an object having a pair of substantially coplanar, spaced-apart marks. The method comprises generating a plurality of images including the spaced-apart marks from signals reflected from the object in a detector plane, measuring energy in the images in the detector plane to produce a plurality of signals, and processing the plurality of signals with calibration data to obtain a vibration measurement of the object. The calibration data is based on a correlation of a change in distance between the spaced-apart marks in the detector plane substantially parallel to the spaced-apart marks to physical movement of the object including the spaced-apart marks.

Independent system claim 10 provides a system for measuring vibration of an object having a pair of substantially coplanar, spaced-apart marks. The system comprises means for generating an image including the spaced-apart marks in a detector plane substantially parallel to the spaced-apart marks, and means for storing calibration data based on a correlation of a change in distance between the spaced-apart marks in the detector plane to physical movement of the object including the spaced-apart marks. The system of claim 10 further provides means for generating a plurality of images including the spaced-apart marks from signals reflected from the object in the detector plane substantially parallel to the spaced-apart marks, at least one detector for measuring energy in the images in the detector plane to

produce a plurality of signals, and a signal processor for processing the plurality of signals with the calibration data to obtain a vibration measurement of the object.

In contrast, *Telschow* teaches an optical beam interferometry system to measure vibration wherein interference fringes are developed between an object light beam and a coherent reference beam. (*Telschow*, Fig. 1, col. 12, ll. 61-64.) The object beam is reflected from a prepared surface of an object. The surface is either diffusively reflective, *i.e.*, rough, or specular reflective, *i.e.*, polished. (*Telschow*, col. 8, ll. 60-65.) Optical interference between the object beam and the reference beam inside a photorefractive material produces vibration measurements distributed over the object. Such interferences produce an image of the vibrating surface having an output intensity that is substantially linear with small physical variations within the vibrating object. A camera aids in detecting the image. (*Telschow*, col. 14, ll. 25-32.) In other words, the photorefractive material optically processes the two beams to provide an output beam intensity that is substantially directly proportional to the vibration displacement amplitude over the object surface. (*Telschow*, col. 12, ll. 5-15.)

The Examiner characterizes *Telschow* as, "providing calibration data based on a correlation of a change in distance in a detector plane substantially parallel to physical movement of the object." (See, Final Office Action dated November 14, 2003 at page 2, ll. 14-15.) Whether or not the Examiner has properly characterized *Telschow*, which Applicants do not concede (*i.e.*, there is no discussion in *Telschow* of a detector plane substantially parallel to physical movement of the object), *Telschow* fails to provide processing a plurality of signals (obtained from measuring energy in images in a detection plane) with calibration data to obtain a vibration measurement of the object.

In particular, as previously mentioned, *Telschow* teaches a processing technique which provides an output beam intensity that is substantially directly proportional to the vibration displacement amplitude over the object surface. One of ordinary skill in the art would understand that the processing technique taught by *Telschow* is an optical processing

technique. Therefore, *Telschow* fails to teach or suggest processing a plurality of signals (obtained by measuring energy in images in a detector plane) with the particular calibration data of the present invention, as set forth in claim 1 to obtain a vibration measurement.

In addition, neither *Telschow* nor *Hashima*, alone or in combination, teach or suggest a signal processor for processing a plurality of signals with the calibration data to obtain a vibration measurement, as set forth in claim 10. Again, *Telschow* teaches the use of a photorefractive material to optically process two beams to provide an output beam whose intensity provides a vibration measurement. One of ordinary skill in the art would recognize that the photorefractive material in *Telschow* processes two beams to obtain such an output beam. *Telschow* does not teach or suggest the limitations of a signal processor for processing a plurality of signals (obtained from at least one detector which measures energy in images in a detector plane) with calibration data to obtain a vibration measurement.

Furthermore, neither of the prior art references cited by the Examiner, alone or in combination, teaches or suggests the use of calibration data which is based on a correlation of a change in distance between spaced-apart marks in a detector plane substantially parallel to the spaced-apart marks to physical movement of the object including the spaced-apart marks, as set forth in claims 1 and 10. *Telschow* only discloses "calibration measurements" "implemented using a piezoelectric translation mirror." (*Telschow*, col. 6, ll. 39-40.) Therefore, *Telschow* fails to teach or suggest the above-noted calibration data of claims 1 and 10.

The Examiner admits that *Telschow* fails to disclose an object having a pair of substantially coplanar, spaced-apart marks. (See, Final Office Action dated November 14, 2003 at pages 3 and 4, ll. 22-1.) Instead, the Examiner depends on the teachings of *Hashima* to provide the required teaching of a pair of substantially coplanar, spaced-apart marks.

Hashima provides a positioning monitoring system utilizing markings on a target object to calibrate the position of the object. The spaced markings have a known displacement and are monitored to determine the position of the target to which they are attached. (See, page 2, ll. 24-28 of the present application.) In the preferred embodiment of *Hashima*, the system includes a target mark (10) disposed on an object (1) and composed of a black circle and a white triangle mounted centrally on the black circle and three-dimensionally shifted from the black circle, a video camera (20) for imaging the target mark (10), a robot (30) supporting the video camera (20) and movable in directions with six degrees of freedom, an image processor (40) for processing image data of the target mark which is produced by the video camera (20), a shift calculating unit (50) for detecting a shift of the target mark (10) from projected histogram information of the target mark (10) which is produced by the image processor (40), and a robot controller (60) for controlling movement of the robot depending on the shift to enable the video camera (20) to track the target mark (10). (*Hashima*, Fig. 1 and Abstract.)

Nowhere does *Hashima* teach or suggest processing a plurality of signals produced by measuring energy in images in a detector plane with the claimed calibration data to obtain a vibration measurement of an object. As such, *Hashima* fails to cure the deficiencies of *Telschow*. The cited references, alone or in combination, fail to teach or suggest the present invention and the rejection should be reversed.

The Examiner also fails to provide the motivation to combine the cited references. The Examiner contends that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated an object with a pair of substantially coplanar, spaced-apart marks of *Hashima* with the photorefractive optical vibration measurement method and system of *Telschow* in order to measure the vibration of an object having spaced-apart marks in a reliable manner. (See, Final Office Action dated November 14, 2003 at page 4, ll. 2-7.)

However, to rely on a reference under 35 U.S.C. §103(a), it must be analogous prior art. "[T]he reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the invention was concerned." (MPEP §2141.01(a), citing *In re Oetiker*, 977 F.2d 1443, 1446, (Fed. Cir. 1992)).

Telschow is directed to an imaging photorefractive optical vibration measurement method and device. (*Telschow*, Title.) *Hashima* is concerned with methods and systems for recognizing and tracking a target mark. (*Hashima*, Title). The present invention is directed to a method and system for measuring vibration of an object. (Title of present invention, Field of the Invention, first object of the invention under Summary of the Invention.) As such, *Hashima* fails to either be in the field of the present invention or to be reasonably pertinent to the particular problem with which the invention was concerned (*i.e.*, providing a cost-effective, high resolution, non-contact vibration measurement from a fairly large stand-off distance). (See, page 1, ll. 19-20; also, page 3, ll. 14-15 and page 6, ll. 7-10 of the present application.) Therefore, there is no suggestion or motivation in the cited references for the combination urged by the Examiner.[1]

Furthermore, the Examiner fails to provide adequate motivation to modify the teaching of *Telschow* as is required for a *prima facie* case of obviousness under 35 U.S.C. §103(a). The mere fact that references can be combined or modified, which Applicants do not concede with respect to the references cited here, does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination or modification. (See, MPEP §2143.01). The Examiner suggests that the combination of *Telschow* and *Hashima* would "measure the vibration of an object having spaced-apart marks in a reliable

[1] Yet further, the present invention has been assigned a preliminary U.S. Classification of 73. (See, Patent Application Publication No. 2003/0164045 A1, dated September 4, 2003.) *Hashima* has current U.S. Classifications of 700/253; 340/815.54; and 382/103. (See, *Hashima*, first page, current U.S. class item in USPTO Patent Full-Text and Image Database.) As such, by the U.S. Patent and Trademark Office classifications, the present invention and *Hashima* cited by the Examiner are in different classes. Therefore, the Examiner has failed to provide evidence that the present invention and *Hashima* are in the same field of endeavor. To the contrary, the present invention and *Hashima* are classified in different fields.

manner." (See Final Office Action dated November 14, 2003, page 4, l. 7.) However, the use of the optical processing technique taught by *Telschow* already alleviates the problem of measuring the vibration of an object having spaced-apart marks stated by the Examiner. Attaching the spaced-apart marks of *Hashima* to a vibrating object of interest would have no effect on the interference fringes that develop between the beams in *Telschow*'s method. Furthermore, *Telschow* requires that the object of interest have a prepared surface that is either diffusive reflective or specular reflective. (*Telschow*, col. 8, ll. 60-65.)

Since there is no proper suggestion or motivation for the combination of *Telschow* and *Hashima*, the Examiner has used impermissible hindsight to combine the teachings of *Telschow* and *Hashima* to attempt to piece together the Applicants' invention. The teaching or suggestion to make the claimed combination must be found in the prior art, not in the applicant's disclosure. (See, MPEP §2143; see also, *In re Dembiczak*, 175 F.3d 994, 999 (Fed. Cir. 1999) ("Combining prior art references without evidence of . . . suggestion, teaching, or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability - the essence of hindsight.")).

The cited art, alone or in combination, fails to teach or suggest the Applicants' invention, as set forth in independent claims 1 and 10. Regarding claims which depend from claims 1 and 10. Applicants contend that these claims are patentable for at least the same reasons that claims 1 and 10 are patentable. For these reasons, the Examiner has failed to make a *prima facie* case of obviousness under 35 U.S.C. §103(a) for the rejection of claims 1-19, and the rejection should be reversed.

IX. CONCLUSION

The Examiner rejected claims 1-19 as being unpatentable under 35 U.S.C. §103(a) over *Telschow* in view of *Hashima*. However, the Examiner has failed to establish a *prima facie* case of obviousness under 35 U.S.C. §103(a). In particular, the references cited

X. APPENDIX - CLAIMS ON APPEAL

1. A method for measuring vibration of an object having a pair of substantially coplanar, spaced-apart marks, the method comprising:

providing calibration data based on a correlation of a change in distance between the spaced-apart marks in a detector plane substantially parallel to the spaced-apart marks to physical movement of the object including the spaced-apart marks;

generating a plurality of images including the spaced-apart marks from signals reflected from the object in the detector plane;

measuring energy in the images in the detector plane to produce a plurality of signals; and

processing the plurality of signals with the calibration data to obtain a vibration measurement of the object.

2. The method of claim 1, wherein the spaced-apart marks are part of the object.

3. The method of claim 1, further comprising the step of marking the object with the spaced-apart marks.

4. The method of claim 1, wherein the signals reflected from the object are light signals and wherein the energy in the images in the detector plane is radiant energy.

5. The method of claim 1, wherein the spaced-apart marks are parallel lines.

6. The method of claim 1, wherein the spaced-apart marks are parts of a single line.

7. The method of claim 6, wherein the single line is a curved line.

8. The method of claim 7, wherein the curved line is a sine or cosine curve.

9. The method of claim 1, wherein the spaced-apart marks are parts of separate lines.

10. A system for measuring vibration of an object having a pair of substantially coplanar, spaced-apart marks, the system comprising:

means for generating an image including the spaced-apart marks in a detector plane substantially parallel to the spaced-apart marks;

means for storing calibration data based on a correlation of a change in distance between the spaced-apart marks in the detector plane to physical movement of the object including the spaced-apart marks;

means for generating a plurality of images including the spaced-apart marks from signals reflected from the object in the detector plane substantially parallel to the spaced-apart marks;

at least one detector for measuring energy in the images in the detector plane to produce a plurality of signals; and

a signal processor for processing the plurality of signals with the calibration data to obtain a vibration measurement of the object.

11. The system as claimed in claim 10, further comprising a marker for marking the object with the pair of substantially coplanar, spaced-apart marks.

12. The system as claimed in claim 10, wherein the substantially coplanar, spaced-apart marks are part of the object.

13. The system as claimed in claim 10, wherein the signals reflected from the object are light signals and wherein the at least one detector comprises an array of photodetectors.

14. The system as claimed in claim 13, wherein the array of photodetectors include a video camera.

15. The system as claimed in claim 10, wherein the spaced-apart marks are parallel lines.

16. The system as claimed in claim 10, wherein the spaced-apart marks are parts of a single line.

17. The system as claimed in claim 16, wherein the single line is a curved line.

18. The system as claimed in claim 10, wherein the spaced-apart marks are parts of separate lines.

19. The system as claimed in claim 17, wherein the curved line is a sine or cosine curve.

by the Examiner, alone or in combination, fail to teach or suggest all the elements of presently pending independent claims 1 and 10. In addition, the Examiner has failed to show a proper suggestion or motivation for combining the references. Dependent claims 2-9 and 11-19 are patentable for at least the same reasons that claims 1 and 10 are patentable. Therefore, the final rejection of claims 1-19 should be reversed.

The fee of $160.00 as applicable under the provisions of 37 C.F.R. § 1.17(c) is enclosed. Please charge any additional fee or credit any overpayment in connection with this filing to our Deposit Account No. 02-3978. A duplicate of this notice is enclosed for this purpose.

Respectfully submitted,

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Enclosure - Appendix